



US006606716B1

(12) **United States Patent**  
Vrhel, Jr. et al.(10) **Patent No.:** US 6,606,716 B1  
(45) **Date of Patent:** Aug. 12, 2003(54) **METHOD AND SYSTEM FOR AUTOMATED  
TECHNICAL SUPPORT FOR COMPUTERS**WO WO 94/08289 4/1994 ..... G06F/9/445  
WO WO 97/09676 \* 3/1997  
WO WO 98/18086 \* 4/1998(75) **Inventors:** Thomas Vrhel, Jr., Austin, TX (US);  
Gary D. Huber, Austin, TX (US); Roy  
W. Stedman, Austin, TX (US); James  
Van Artsdalen, Austin, TX (US);  
Krishnamurthy Venkatramani, Austin,  
TX (US)**OTHER PUBLICATIONS**CNET.com, "IBM to Get Colorful with New Notebooks" at  
Internet>http://news.cnet.com/news/0-1003-200-296049.  
html?tag=st.cn.1fd2.<, printed Oct. 6, 1999.\*(73) **Assignee:** Dell USA, L.P., Round Rock, TX (US)3Com, "Palm Computer, News and Promotions" at Internet  
>http://www.palm.com/pr/holidaydebut.html<, printed Oct.  
5, 1999.(\*) **Notice:** Subject to any disclaimer, the term of this  
patent is extended or adjusted under 35  
U.S.C. 154(b) by 0 days.@Backup Company, "@Backup Company Information  
Page" at Internet, http://security.atbackup.com/  
VID101.3.819255.0/Company.htm, printed Jun. 15, 1999.(21) **Appl. No.:** 09/413,422(22) **Filed:** Oct. 6, 1999

(List continued on next page.)

(51) **Int. Cl.<sup>7</sup>** ..... G06F 11/00(52) **U.S. Cl.** ..... 714/32; 714/34; 714/46(58) **Field of Search** ..... 714/26, 27, 32,  
714/34, 36, 37, 40, 46, 55, 23(56) **References Cited****U.S. PATENT DOCUMENTS**

4,253,178 A	2/1981	Kolaczia	368/285
4,356,545 A	10/1982	West	364/200
4,438,458 A	3/1984	Munscher	358/254
4,491,914 A	1/1985	Sujaku	364/200
4,627,060 A	12/1986	Huang et al.	371/62
4,635,187 A	1/1987	Baron et al.	364/200
4,788,658 A	11/1988	Hanebuth	364/900
4,809,280 A	2/1989	Shonaka	371/62
4,916,699 A	4/1990	Ohashi	364/900
4,964,077 A	* 10/1990	Eisen et al.	364/900

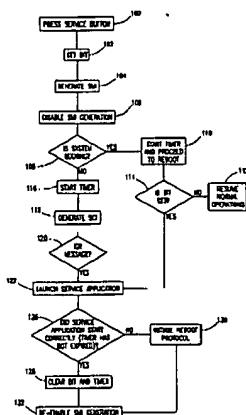
(List continued on next page.)

**FOREIGN PATENT DOCUMENTS**

GB	2065939	7/1981	.....	G06F/11/30
GB	2329266	3/1999	.....	G06F/11/00
GB	2356271	5/2001	.....	G06F/11/00
WO	WO 93/00628	1/1993	.....	G06F/1/24

**Primary Examiner**—Robert Beausoliel**Assistant Examiner**—Marc M Duncan(74) **Attorney, Agent, or Firm**—Baker Botts L.L.P.(57) **ABSTRACT**

A method and system for automated support in a computer system. The computer system has a service button, and pressing of the service button causes a bit to be set in a register in the chip set. Setting of the bit generates an interrupt signal that is received and processed in a manner dependent on whether the computer system is in a booting state or a non-booting state. If the computer system is in a booting state, the bit is checked at a predetermined point in the booting sequence, and if set, a service application is initiated at that time. If the computer is not in a booting state, a second interrupt is generated, causing the service application to be initiated. A timer is initiated substantially with pressing of the service button, and if the service application reaches a predetermined point before the timer reaches a predetermined value, it will clear the timer. If not, the system will follow a predetermined reboot protocol.

**31 Claims, 3 Drawing Sheets**

## U.S. PATENT DOCUMENTS

5,010,551 A	4/1991	Goldsmith et al.	371/16.4	5,809,248 A	*	9/1998	Vidovic	395/200.49
5,017,030 A	5/1991	Crews	400/485	5,809,511 A	*	9/1998	Peake	707/204
5,060,135 A	10/1991	Levine et al.	364/200	5,818,635 A		10/1998	Hohn et al.	359/612
5,196,993 A	3/1993	Herron et al.	361/393	5,819,274 A	*	10/1998	Jackson, Jr.	707/10
5,214,695 A	5/1993	Arnold et al.	380/4	5,825,355 A	*	10/1998	Palmer et al.	345/336
5,224,024 A	6/1993	Tu et al.	364/429	5,825,506 A		10/1998	Bednar et al.	358/402
5,228,655 A	7/1993	Garcia et al.	248/118	5,826,839 A	*	10/1998	Chen	248/118
5,276,805 A	1/1994	Hamaguchi	395/164	5,832,522 A	*	11/1998	Blickenstaff et al.	707/204
5,287,448 A	2/1994	Nicol et al.	395/159	5,835,344 A		11/1998	Alexander	361/683
5,287,505 A	2/1994	Calvert et al.	395/600	5,845,136 A	*	12/1998	Babcock	395/750.01
5,325,521 A	6/1994	Koyama et al.	375/575	5,852,545 A		12/1998	Pan-Ratzlaff	361/683
5,346,410 A	9/1994	Moore, Jr.	439/607	5,854,828 A		12/1998	Kocis et al.	379/93.31
5,348,408 A	9/1994	Gelardi et al.	400/715	5,860,001 A		1/1999	Cromer et al.	395/651
5,353,240 A	10/1994	Mallory et al.	364/552	5,860,002 A		1/1999	Huang	395/652
5,355,357 A	10/1994	Yamamori et al.	369/75.2	5,860,012 A		1/1999	Luu	395/712
5,356,099 A	10/1994	Sereboff	248/118.1	5,861,884 A	*	1/1999	Fujioka	345/338
5,367,667 A	11/1994	Wahlquist et al.	395/575	5,881,236 A		3/1999	Dickey	395/200.51
5,374,018 A	12/1994	Daneshvar	248/118	5,884,073 A		3/1999	Dent	395/652
5,375,800 A	12/1994	Wilcox et al.	248/118	5,894,571 A		4/1999	O'Connor	395/692
5,381,526 A	1/1995	Ellson	395/164	5,904,327 A	*	5/1999	Cheng	248/118.1
5,388,032 A	2/1995	Gill et al.	364/146	5,905,632 A		5/1999	Seto et al.	361/683
5,390,324 A	2/1995	Burckhardt et al.	395/575	5,906,506 A	*	5/1999	Chang et al.	439/500
5,392,095 A	*	2/1995	Siegel	5,909,544 A		6/1999	Anderson, II et al.	395/200.38
5,398,333 A	*	3/1995	Schieve et al.	5,939,694 A		8/1999	Holcomb et al.	235/381
5,410,447 A	4/1995	Miyagawa et al.	361/681	5,953,533 A		9/1999	Fink et al.	395/712
5,422,751 A	6/1995	Lewis et al.	359/83	5,955,797 A		9/1999	Kim	307/150
5,423,605 A	*	6/1995	Liu	5,960,189 A		9/1999	Stupek, Jr. et al.	395/500.43
5,432,927 A	7/1995	Grote et al.	395/575	5,960,204 A		9/1999	Yinger et al.	395/712
5,443,237 A	8/1995	Stadtmauer	248/441.1	5,960,411 A		9/1999	Hartman et al.	705/26
5,450,576 A	9/1995	Kennedy	395/650	5,963,743 A		10/1999	Amberg et al.	395/712
5,454,080 A	9/1995	Fasig et al.	395/283	5,974,546 A		10/1999	Anderson	713/2
5,455,933 A	*	10/1995	Schieve et al.	5,978,911 A		11/1999	Knox et al.	713/1
5,471,674 A	11/1995	Stewart et al.	395/650	5,983,369 A		11/1999	Bakoglu et al.	714/46
5,483,437 A	*	1/1996	Tang	5,991,543 A		11/1999	Amberg et al.	395/712
5,503,484 A	4/1996	Louis	400/489	5,995,757 A		11/1999	Amberg et al.	395/712
5,513,319 A	4/1996	Finch et al.	395/185.08	6,006,344 A	*	12/1999	Bell, Jr.	714/37
5,522,572 A	6/1996	Copeland et al.	248/118	6,012,154 A		1/2000	Poisner	714/55
5,526,180 A	6/1996	Rausnitz	359/609	6,014,744 A		1/2000	McKaughan et al.	713/2
5,530,847 A	6/1996	Schieve et al.	395/183.14	6,023,267 A		2/2000	Chapuis et al.	345/327
5,537,585 A	*	7/1996	Blickenstaff et al.	6,029,257 A		2/2000	Palmer	714/40
5,537,618 A	*	7/1996	Boulton et al.	6,029,258 A		2/2000	Ahmad	714/46
5,547,154 A	8/1996	Kirchoff et al.	248/118.3	6,032,157 A		2/2000	Tamano et al.	707/104
5,547,272 A	8/1996	Paterson et al.	312/223.2	6,034,869 A		3/2000	Lin	361/686
5,564,054 A	10/1996	Bramnick et al.	395/700	6,038,597 A		3/2000	Van Wyngarden	709/219
5,592,362 A	1/1997	Ohgami et al.	361/686	6,047,261 A		4/2000	Siefert	705/11
5,596,481 A	1/1997	Liu et al.	361/683	6,048,454 A		4/2000	Howell et al.	361/686
5,596,482 A	1/1997	Horikoshi	361/683	6,049,342 A		4/2000	Nielson et al.	345/473
5,627,964 A	5/1997	Reynolds et al.	395/183.22	6,050,833 A		4/2000	Danzyger et al.	439/92
5,649,200 A	7/1997	Leblang et al.	717/122	6,056,136 A		5/2000	Taber et al.	215/252
5,668,992 A	9/1997	Hammer et al.	395/651	6,061,788 A		5/2000	Reynaud et al.	713/2
5,678,002 A	10/1997	Fawcett et al.	395/183.01	6,061,810 A		5/2000	Potter	714/23
5,680,640 A	*	10/1997	Ofek et al.	6,065,136 A		5/2000	Kuwabara	714/31
5,689,253 A	11/1997	Hargreaves et al.	341/22	6,104,874 A		8/2000	Branson et al.	395/702
5,689,706 A	*	11/1997	Rao et al.	6,108,697 A		8/2000	Raymond et al.	709/218
5,694,293 A	12/1997	Seto et al.	361/687	6,112,320 A		8/2000	Dien	714/51
5,708,776 A	1/1998	Kikinis	395/185.08	6,113,050 A		9/2000	Rush	248/346.01
5,708,812 A	1/1998	Van Dyke et al.	395/712	6,166,729 A		12/2000	Acosta et al.	345/327
5,724,224 A	3/1998	Howell et al.	361/680	6,167,383 A		12/2000	Henson	705/26
5,727,163 A	3/1998	Bezos	395/227	6,167,532 A		12/2000	Wisecup	714/23
5,732,268 A	3/1998	Bizzarri	395/652	6,170,065 B1		1/2001	Kobata et al.	714/7
5,748,877 A	*	5/1998	Dollahite et al.	6,182,212 B1		1/2001	Atkins et al.	717/1
5,759,644 A	6/1998	Stanley	428/14	6,182,275 B1		1/2001	Beelitz et al.	717/1
5,768,370 A	6/1998	Maatta et al.	379/433	6,199,204 B1		3/2001	Donohue	717/11
5,775,822 A	7/1998	Cheng	400/489	6,202,207 B1		3/2001	Donohue	717/11
5,778,372 A	7/1998	Cordell et al.	707/100	6,226,412 B1		5/2001	Schwab	382/232
5,790,796 A	*	8/1998	Sadowsky	6,236,901 B1		5/2001	Goss	700/95
5,796,579 A	8/1998	Nakajima et al.	361/683	6,247,126 B1		6/2001	Beelitz et al.	713/1
5,797,281 A	8/1998	Fox	63/12	6,256,620 B1		7/2001	Jawahar et al.	707/2
5,803,416 A	9/1998	Hanson et al.	248/118	6,263,215 B1		7/2001	Patton et al.	455/561
5,805,882 A	9/1998	Cooper et al.	395/652	6,272,484 B1		8/2001	Martin et al.	707/1
				6,279,109 B1		8/2001	Brundridge	712/2

6,279,125 B1	8/2001	Klein .....	714/38
6,279,156 B1	8/2001	Amberg et al. ....	717/11
6,298,443 B1	10/2001	Colligan et al. ....	713/200
6,298,457 B1	10/2001	Rachlin et al. ....	714/49
6,331,936 B1	12/2001	Hom et al. ....	361/686
6,356,977 B2	3/2002	Ofek et al. ....	711/112
6,367,035 B1	4/2002	White .....	714/40
6,385,737 B1 *	5/2002	Benignus et al. ....	714/22
6,393,586 B1	5/2002	Sloan et al. ....	714/25
6,449,735 B1	9/2002	Edwards et al. ....	714/25

## OTHER PUBLICATIONS

@Backup Company, "@Backup Company Frequently Asked Questions" at Internet, <http://security.atbackup.com/VID101.3.819255.0/FAQ.asp>, printed Jun. 15, 1999.

@Backup Company, "Frequently Asked Questions: Technical" at Internet, <http://security.atbackup.com/VID101.3.819255.0/Tech.asp>, printed Jun. 15, 1999.

@Backup Company, "Are You Protected" at Internet, <http://security.atbackup.com/VID101.3.819255.0/Main.asp>, printed Jun. 15, 1999.

Exploring Windows NT "ZD Journals" at Internet ><http://www.zdjournal.com/9802.cwn9821.html><, printed Oct. 18, 1999.

PCWorld News "Compaq Debuts Home PCs" at Internet ><http://www2.pcworld.com.html><, printed Oct. 18, 1999.

"HP builds in Net button," at Internet <<http://news.cnet.com/news/0-1003-202-316545.html>>, printed Oct. 18, 1999.

"Packard Bell PCs provide state-of-the-art technology and complete user support" at <<http://www.gadgetguru.com.html>>, printed Oct. 18, 1999.

Compaq Computer Corporation, Press Release, "New PCs Offer Equipment, Colour and Personality; Compaq's Presario Range Opened Up for Customisation" at Internet >[http://biz.yahoo.com/prnews/000719/compaq\\_new.html](http://biz.yahoo.com/prnews/000719/compaq_new.html)<, printed Jul. 24, 2000.

Compaq Computer Corporation, "Home and Home Office Computing, My Style" at Internet ><http://athome.compaq.com/showroom/static/splash.asp><, printed Jul. 18, 2000.

Epson, "Epson Stylus Color 74i It makes a Colorful Case for Being Your iMac Printer" at Internet ><http://www.epson.com/printer/inkjet/sty740i.html><, printed Jul. 24, 2000.

Radio Shack, advertisement, p. 2, Aug. 20, 2000.

Pending patent application Ser. No. 09/236,862: Alan E. Beelitz, Richard D. Amberg; "Recoverable Software Installation Process and Apparatus for a Computer System"; Dell USA, L.P., filed Jan. 25, 1999.

Pending patent application 09/245,148: Jeffrey N. Sloan, Tim Sullivan, David S. Springer, "Method and Apparatus for Diagnosing and Conveying an Identification Code in Post on a Non-Booting Personal Computer"; Dell USA, L.P., filed Feb. 4, 1999.

Great Britain Search and Examination Report 0019866.3, Mar. 12, 2001.

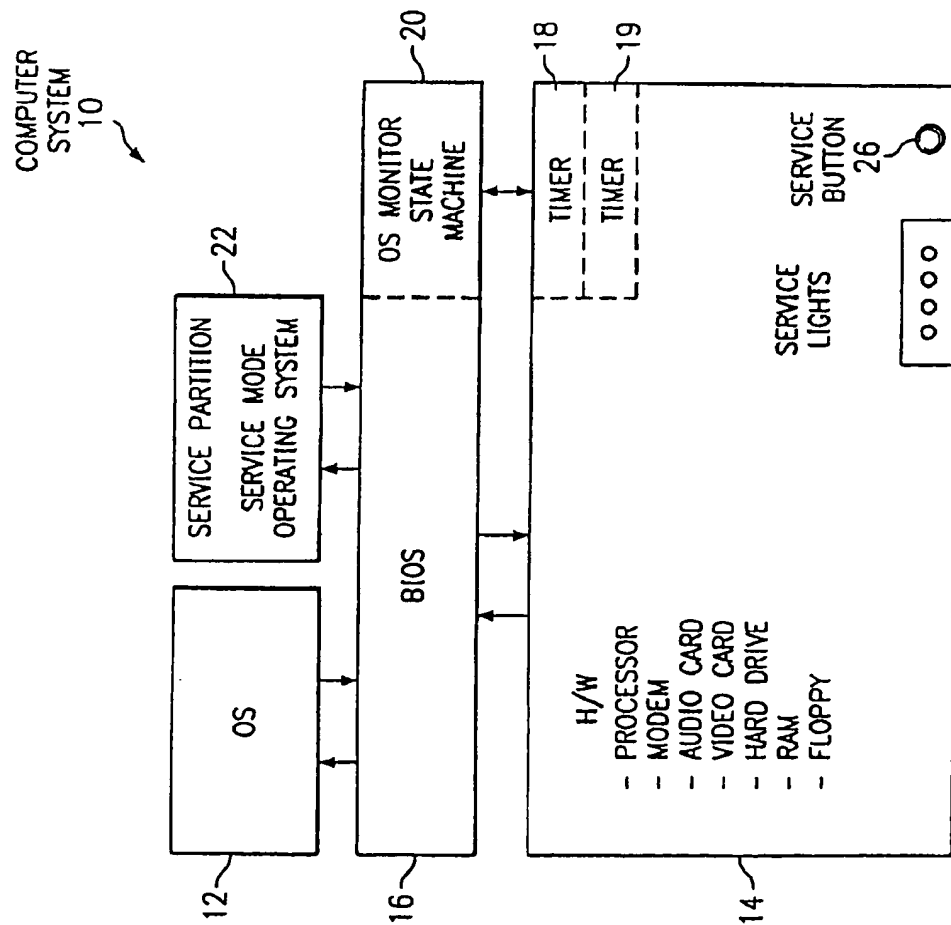
Wilson et al., "Knowledge based interface to manufacturing computer system," ACM pp. 1183-1189.

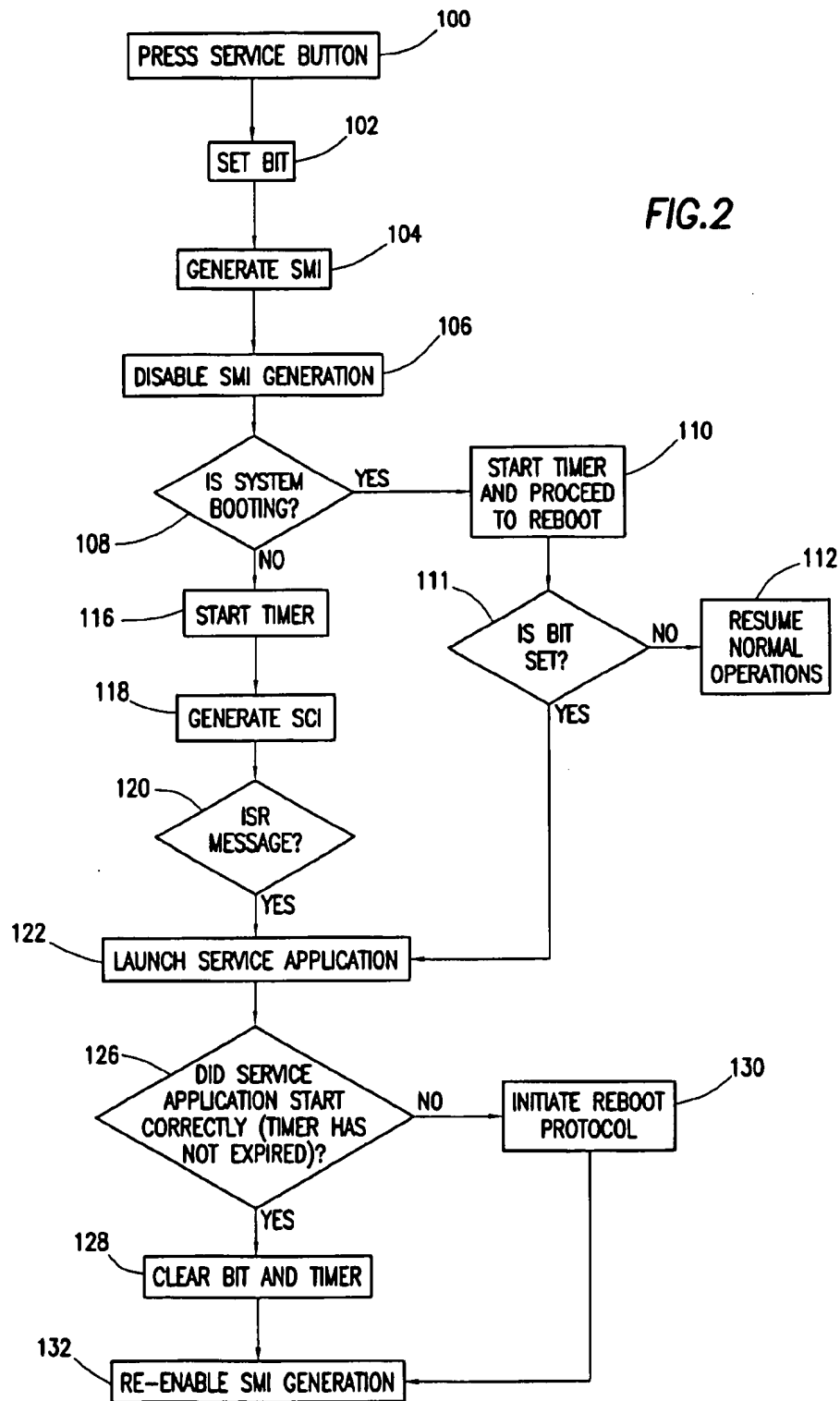
Green, "Component based software development: implications for documentation", ACM pp. 159-164.

Hall et al., "A Cooperative approach to support software deployment using software dock", ACM ICSE pp. 174-183.

Written Opinion for Singapore Application No. 20000438002 Feb. 8, 2000.

\* cited by examiner





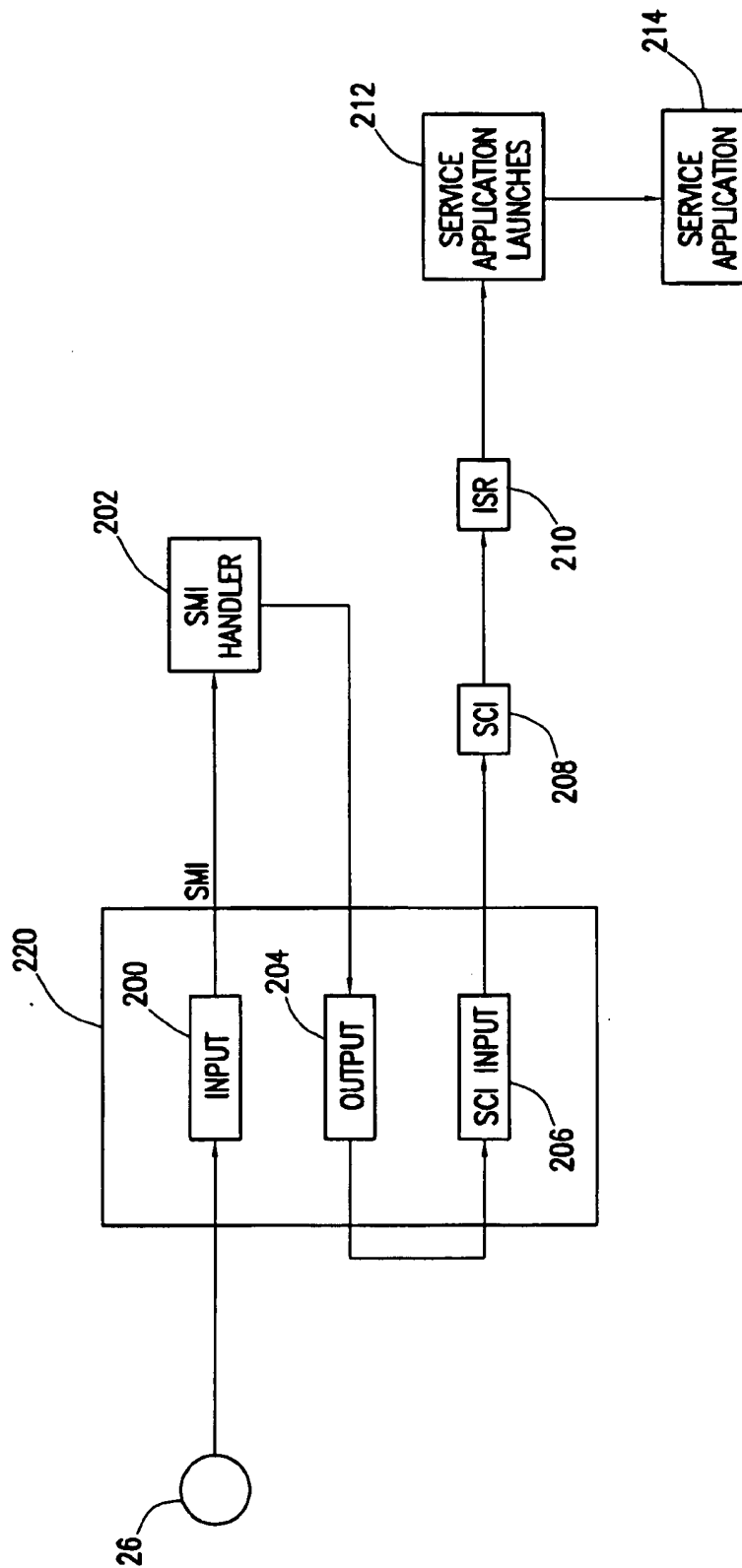


FIG. 3

## METHOD AND SYSTEM FOR AUTOMATED TECHNICAL SUPPORT FOR COMPUTERS

### TECHNICAL FIELD

This patent application relates in general to the field of computing devices, and more particularly to a method and system for automating support for computers.

### BACKGROUND

Personal computer systems have become increasingly common in businesses and households. Although the term "personal computer" implies a generic device, "personal computers" generally have a wide diversity of hardware and software components. For instance, different personal computers may have processors and buses of different speeds, hard drive and RAM memories of different sizes, and peripheral devices interfaced with different types of interface cards, such as audio devices. Further, a large array of manufacturers produce computer components so that in a given personal computer, even components having substantially similar operating characteristics may have important differences based on each component's manufacturer specification.

With respect to software, generally all personal computers have a common need for an operating system that coordinates the operation of hardware components. However, each individual personal computer may have one of many possible operating systems. For instance, Microsoft products have evolved from its original Disk Operating System ("DOS") to Windows systems, including Windows 3.1, Windows 95, Windows 98, Windows CE and Windows NT. In addition to these Microsoft operating systems, other types of operating systems are available, such as different versions of Unix, including Linux.

In addition to this wide diversity of operating systems, personal computers may operate a large number of different types of software applications. A given software application may interact in different manners with different operating systems. Thus, even with substantially similar hardware components, personal computers having different software may operate in substantially different manners.

Computer users can experience difficulties in system operation for many reasons. Lack of knowledge, hardware faults, software incompatibilities, and many other causes can lead to problems for the computer user. Given the wide range of hardware and software available (which implies an even greater range of hardware/software combinations that a user can experience), it is difficult to determine if the computer has a problem.

This situation is further complicated by the fact that personal computers do not have good mechanisms to automatically determine if the hardware/software system is having a problem. While certain operating systems contain code that help sense some types of problems with specific pieces of hardware, such mechanisms may be insufficiently uniform for determining if the operating system has a problem. Indeed, a common symptom of an operating system problem is a failure to boot, in which case the OS cannot be counted on to help. Another common symptom of an operating system problem is a hang, in which case the operating system becomes unresponsive to the keyboard and mouse for a wide variety of possible causes. It should be noted that this type of problem can be caused by pieces of software which have been installed on top of the operating system, such as an application or driver, or some incompat-

ibility between pieces of software that have been loaded. A system that was operational may stop functioning at some later point due to software incompatibilities.

Another issue is the lack of a uniform mechanism for the user to invoke assistance. If the user has a question or the system has a problem, or at least the user perceives a problem, there is currently no uniform mechanism to get the system to attempt to provide assistance to the user. Although there are various types of help available to the user, they rely on one or more working input devices, such as a mouse and/or a keyboard, and a sufficient level of user knowledge to be able to navigate to one of a variety of information sources on the system and on a global information source such as the internet.

### SUMMARY

Therefore, a need has arisen for a method and system for identifying and resolving personal computer system problems that is accessible through a uniform fail-safe mechanism regardless of the functional state of the operating system and other software, and can be implemented on a wide variety of operating systems.

A further need exists for a method and system that detects when an operating system has failed to boot or has hung and can take appropriate corrective actions.

A further need exists for such a system that includes a monitoring system that communicates with the operating system and vice versa, and that is capable of doing so with a wide variety of different operating systems.

A further need exists for such a standard mechanism that will attempt to resolve operating system hang conditions regardless of whether the assistance has been requested by the user during boot or otherwise, and regardless of whether the user has made multiple requests for assistance.

In accordance with the present disclosure, a method and system is provided that substantially eliminates or reduces disadvantages and problems associated with previously developed methods and systems for identifying computer system problems. A monitoring system detects problems with a computer system and aides in identifying and resolving the problems. The current level of functionality of the computer system is determined, and technical support is provided for the computer system in accordance with the functionality of the computer system.

For example, in one embodiment, a user initiates operating system monitoring by pressing a service button to indicate a problem with the computer system. The pressing of the service button initiates support functions, such as the initiation of a service application, at an appropriate time. The support functions allow testing of the computer system by the monitoring system. The service button initiates a watchdog timer that acts as a hang detection timer. An operating system hang-up error is identified if the hang detection timer remains uncleared after a predetermined hang detection time. Detection of a computer failure results in the system following a predetermined reboot protocol, such as that described in co-pending U.S. application Ser. No. 09/377, 726, which is incorporated herein by reference.

More specifically, in one embodiment a method for automated support is provided in a computer system having a service button and a controller chip set. The method includes the steps of pressing the service button, setting a first bit in a general purpose input register in the controller chip set to generate a first interrupt signal in response to the pressing step, receiving the first interrupt and determining whether the computer system is booting, and if the system is booting

3

then initiating a service application routine in a first manner, or if the system is not booting then initiating a service application routine in a second manner.

A method is also provided for automated support of a computer system having a controller chip set including the steps of pressing a service button, setting a bit in a general purpose input register in the chip set, generating a first interrupt of a first type as a result of the bit being set, and initiating a service application in a manner dependent on whether the computer system is booting or not.

A computer system is also provided having a processor with at least one timer, a controller chip set, a system BIOS, and an operating system for communicating with components of the computer system through the BIOS. A service button is coupled with a general purpose input register in the chip set for setting the register for generating a first interrupt. The system further includes an interrupt handler that is coupled to the input register for receiving the first interrupt and processing it in a manner dependent on whether the computer system is in a booting state or a nonbooting state.

A computer system having a system BIOS and an operating system is also provided, wherein the computer system includes a service button coupled to a general purpose input register in a controller chip set for setting a bit in the register to generate a first interrupt signal. An interrupt handler in the system BIOS receives the first interrupt signal and initiates a second interrupt signal to the operating system to initiate a service application if the computer system is not in a booting state. If the computer is in a booting state the bit remains set, and code contained within the operating system checks the status of the bit later during the booting sequence and initiates the service application if the bit has been set.

The present invention provides many important technical advantages. One important technical advantage is integrated support for detecting problems associated with computer systems. One such advantage is a robust user interface that is simple and uncomplicated to use. For instance, a user with a question or problem simply pushes a single service button. Pressing the service button generates an interrupt directly into the chip set to alert the monitoring system that service is requested by the user. The direct interface of the service button to the chip set enhances reliability and simplicity, as the user's input to the service button does not have to rely on the operation of computer components, such as a keyboard or mouse. Additionally, a user may press the service button at any time to seek assistance. The means by which pressing of the service button initiates a service application ensures that the service application will be run at the appropriate time, regardless of when the service button is pressed, and regardless of whether it is pressed multiple times. Further, the system and method of the present invention can be easily implemented with a variety of different operating systems.

#### BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention and advantages thereof may be acquired by referring to the following description taken in conjunction with the accompanying drawings, in which like reference numbers indicate like features, and wherein:

FIG. 1 depicts a block diagram of a computer system monitored by an operating system monitor state machine;

FIG. 2 depicts a flow diagram of initiation of a service application following pressing of a service button; and

FIG. 3 depicts a block diagram of software and hardware elements used to initiate a service application.

4

#### DETAILED DESCRIPTION

Preferred embodiments of the present invention are illustrated in the Figures, like numeral being used to refer to like and corresponding parts of the various drawings.

A healthy operating system monitors hardware and software operations on a computer system. At times, the operating system detects difficulties or problems with the computer system and provides notice of the difficulties or problems to the computer system user. Help systems generally associated with the operating system can help to resolve difficulties or problems either automatically or through user interaction, such as by asking questions. However, when the operating system itself has a problem or there are software incompatibilities, it is difficult for the operating system to address those problems. Frequently, the operating system either shuts down or hangs up without providing further notice of the problem to the computer system user.

To improve computer system problem detection, identification and resolution, a monitoring system associated with the computer system's BIOS monitors operating system functionality. The monitoring system detects operating system boot failures and various types of operating system hang-ups. Once a problem is detected, remedial action is automatically taken to recover a failed computer system using a uniform mechanism that takes advantage of operational aspects of the computer system. For instance, a single push of a service button provides an interrupt to the computer system chip set for automatically invoking the highest available level of user assistance as determined by computer system health and state. The service button may be pressed by a user while the computer system is in POST, booting, in service mode or in normal mode. When the service button is pressed, the BIOS sets a bit in a general purpose input register in the controller chip set and generates an interrupt. State-sensitive interrupt handler code in BIOS takes appropriate action, and may communicate to the operating system, depending upon the state of computer system as represented by certain CMOS bits. Further, the interrupt handler code ensures that only appropriate action is taken regardless of the number of times the service button is successively pressed. The manner in which the service button invokes user assistance will now be described in more detail with reference to FIGS. 1-3.

Referring now to FIG. 1, a block diagram depicts a computer system 10 having an operating system 12 interfaced with hardware components 14 through a basic input output system ("BIOS") 16. Hardware components 14 include conventional personal computer system hardware components such as a processor, modem, audio card, video card, and storage devices, including a hard drive, floppy drives, ROM and RAM. On initial power-up or upon initiation of a reboot, BIOS 16 directs a boot sequence, including a power on self test ("POST") and calling of the operating system. Within hardware 14 resides one or more timers 18 and 19, such as conventional watchdog timers.

Computer system 10 includes a service button 26 available for a computer user to press. Service button 26 provides a robust user interface that enables a user to initiate the problem detection and identification process. Service button 26 generates an interrupt into the computer system chip set to, for instance, initiate a service application. Monitor state machine 20 detects pressing of the service button and launches the service application at an appropriate time, or monitors the system behavior to detect computer system problems. Monitor state machine 20 monitors the function-



ing of operating system 12 with a watchdog or "hang detection" timer 19. When the service button is pressed, hang detection timer 19 is initiated, and is later cleared by an application run after completion of the calling up and booting of operating system 12 or service mode operating system 22. If the application does not clear hang detection timer 19 within a predetermined period of time, monitoring state machine 20 determines that an operating system hang-up has occurred. BIOS 16 then recognizes an operating system problem and initiates a predetermined reboot protocol, such as that described in co-pending U.S. application Ser. No. 09/377,726, which is incorporated herein by reference.

As indicated above, the service button provides a standard mechanism through which a user can invoke assistance. Referring now to FIGS. 2 and 3, a user who seeks to invoke assistance will press service button 26 at step 100. Note that although not specifically shown, the flow chart depicted in FIG. 2 involves two execution spaces, one within the BIOS and the other within the operating system execution space. In general, communication to the operating system is handled by generating an interrupt, such as a system control interrupt (SCI), while communication from the operating system back to the BIOS is accomplished by running code that sets values in the BIOS, such as clearing a hang detection timer. The means by which the monitoring system in the BIOS communicates with the operating system and the operating system responds (if not hung), as will be more fully described below, provides unique advantages. Although the system is of necessity operating-system dependant since some portions reside within the operating system, it is also capable of leveraging the underlying personal computer architecture to allow the same mechanism in the BIOS to support multiple operating-system specific implementations. Further, the system enables user assistance to be invoked regardless of the functional state of the operating system.

As shown in FIG. 3, the service button 26 is wired directly to a specific input register 200 in the general purpose input/output register (GPIO) of the controller chip set 220, and pressing of the service button causes a bit in that input register to be set at step 102. The setting of this bit generates a system management interrupt (SMI) at step 104 to initiate state-sensitive interrupt handler code, an SMI handler 202, in the BIOS. The SMI handler 202 receives the SMI, and disables further SMI generation at step 106 until the present SMI has been serviced to ensure that if a user presses the service button multiple times, only one interrupt will be generated until that interrupt has been fully serviced.

At step 108, the SMI handler determines whether the computer system is booting by examining the appropriate bit in the CMOS register. If the system is currently booting, the general purpose input bit remains set while the system continues its boot sequence. A hang detection timer is also set at step 110, but the SMI handler takes no further action. When the system completes its boot sequence, or at a predetermined point in the booting sequence where it is known that hardware and software tested and run up to that point in the boot sequence are generally operational, such as when the user is prompted for a login ID, the operating system is directed to check the status of the service button bit at step 111. If the service button bit has been set, indicating that the button was pressed during boot, the operating system will launch a service application at step 122, otherwise it will resume normal operations (step 112). In one embodiment, a background task such as a service application launcher associated with the operating system,

which is run as part of the normal boot process, checks the service button bit. If the service button bit is set, the service application launches the service application.

If, at step 108, the SMI handler determines that the system is not booting, the SMI handler initiates a hang detection timer at step 116. This hang detection timer could be the same timer as would be set in step 110 above or a different timer. The value to which the timer is set, however, will be different depending on whether the service button was pressed during boot or otherwise. If pressed during boot it will be set to a higher value, representing the longer amount of time required to allow the system to complete the boot cycle and launch the service application. If not pressed during boot, the timer will be set to a lower value, representing the shorter amount of time required to allow the system to process the interrupt (described below) and start the service application.

If the system is not booting, the SMI handler code in the BIOS subsequently communicates with the operating system by causing an interrupt at step 118. In one embodiment, this interrupt is a system control interrupt (SCI) that is serviced in operating system execution space. To initiate the SCI, the SMI handler sets an output bit 204 in an output register in the GPIO. As shown in FIG. 3, this bit is used as an input to a system control interrupt input 206, which in turn initiates the SCI 208. At step 120, the SCI is processed by an interrupt service routine (ISR) 210 in the operating system execution space. The ISR provides a message to the operating system to initiate a service application. In one embodiment this is achieved by sending a message to the service application launcher 212 associated with the operating system, which starts the service application 214 at step 122.

Regardless of whether the service button was pressed during boot or otherwise, if the service application starts correctly, as determined at step 126, the service button bit and hang detection timer are cleared at step 128. In one embodiment, the service application notifies the service application launcher and instructs it to clear the service button bit and the hang detection timer. If the service application has not started correctly (the timer has reached zero before being cleared), it may indicate an operating system hang-up or, at minimum, that it is incapable of properly starting the service application. Thus, the system begins to follow a predetermined reboot protocol in step 130, such as that described in detail in co-pending U.S. application Ser. No. 09/377,726, which is incorporated herein by reference. Finally, once the SMI has been fully serviced the SMI handler reenables SMI generation at step 132 so that subsequent pressing of the service button will cause another interrupt and initiate servicing as described above.

Thus, the system and method of the present invention provide a unique way in which to invoke user assistance in a uniform fail-safe way. The manner in which the code in the BIOS execution space communicates with the operating system and vice versa enables invocation of a service request that is operating system independent, and provides a monitoring system that is outside of the operating system so as to be able to monitor the operating system itself. Further, the system and method described above enables a user to invoke assistance regardless of the state of the operating system (i.e. during booting or otherwise, or when the operating system is hung).

Although the present invention has been described in detail, it should be understood that various changes, substi-

tutions and alterations can be made hereto without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A method for automated support in a computer system having a service button and a controller chip set comprising the steps of:

pressing said service button;

setting a first bit in a general purpose input register in the controller chip set to generate a first interrupt signal in response to said pressing step;

receiving said first interrupt signal; and

determining whether or not said computer system is executing a booting sequence, wherein:

if said computer system is not executing said booting sequence, then generating a second interrupt signal, said second interrupt signal initiating an interrupt service routine, and said interrupt service routine initiating a service application; or

if said computer system is executing said booting sequence, then checking the status of said first bit at a predetermined point during the booting sequence; and if said first bit is set, initiating said service application at a predetermined time during said booting sequence.

2. The method according to claim 1, further comprising the step of initiating a timer in response to said pressing step.

3. The method according to claim 2, further comprising the step of clearing said timer if said service application reaches a predetermined point before said timer reaches a predetermined value.

4. The method according to claim 3, further comprising the step of initiating a predetermined reboot protocol if said service application has not reached said predetermined point prior to said timer reaching said predetermined value.

5. The method according to claim 1, wherein said second interrupt signal is a system control interrupt, and said step of initiating said system control interrupt further comprises the step of setting a second bit in a general purpose output register of said controller chip set, said setting of said second bit causing the generation of said system control interrupt.

6. The method according to claim 1, further comprising the step of disabling generation of subsequent first interrupt signals until said first interrupt signal has been processed.

7. The method according to claim 6, wherein said computer system further includes a system BIOS, and wherein an interrupt handler in said system BIOS receives said first interrupt and performs said determining and disabling steps.

8. A method for automated support in a computer system having a controller chip set comprising the steps of:

pressing a service button;

setting a bit in a general purpose input register in said chip set;

generating a first interrupt of a first type as a result of said bit being set; and

determining whether or not said computer system is executing a booting sequence, wherein:

if said computer system is executing said booting sequence, then initiating a service application at a predetermined point during said booting sequence, otherwise

if said computer system is not executing said booting sequence, then generating an interrupt of a second type to initiate said service application.

9. The method according to claim 8, wherein said interrupt of said second type is a system control interrupt, and wherein said method further comprises the steps of:

said system control interrupt initiating an interrupt service routine; and

said interrupt service routine causing initiation of said service application.

10. The method according to claim 9 further comprising the step of disabling generation of subsequent first type of interrupts until said first interrupt has been processed.

11. The method according to claim 9, wherein said step of generating said system control interrupt further comprises the step of setting a bit in a general output register of said chip set, said output bit causing a third register to generate a system control interrupt signal to cause generation of said system control interrupt.

12. The method according to claim 11, wherein an interrupt service routine receives said interrupt of said first type and performs said determining and disabling steps.

13. The method according to claim 12, wherein said computer system further includes an operating system for supporting computer system operations and a system BIOS, said interrupt handler being in said system BIOS.

14. The method according to claim 13, wherein said interrupt service routine is in said operating system.

15. The method according to claim 8, further comprising the step of initiating a timer substantially when said service button is pressed.

16. The method according to claim 15, further comprising the step of clearing said timer if said service application reaches a predetermined point before said timer reaches a predetermined value.

17. The method according to claim 16, further comprising the step of initiating a predetermined reboot protocol if said service application has not reached said predetermined point prior to said timer reaching said predetermined value.

18. A computer system comprising:

a processor having at least one timer;

a controller chip set;

a system BIOS;

an operating system for supporting computer system operations and for communicating with components of said computer system through said BIOS;

a service button coupled with a general purpose input register in said chip set for setting said register to generating a first interrupt;

an interrupt handler, said interrupt handler being coupled with said input register for receiving said first interrupt and processing said interrupt in a manner dependent on whether the computer is in a booting state or a non-booting state.

19. The computer system according to claim 18, wherein said interrupt handler comprises code in the system BIOS.

20. The computer system according to claim 19, wherein said interrupt handler determines if said computer system is in said booting or said non-booting state, said interrupt handler being coupled with a general purpose output register in said chip set for setting a bit in said output register if said computer system is in said non-booting state.

21. The computer system according to claim 20, wherein said general purpose output register is coupled with a third register in said chip set, said third register generating an interrupt signal for initiating a second interrupt when said bit in said output register is set.

22. The computer system according to claim 21, wherein said second interrupt calls an interrupt service routine.

23. The computer system according to claim 22, wherein said interrupt service routine is in said operating system.

24. The computer system according to claim 23, wherein said operating system includes code for checking the status

9

of said input register at a predetermined time when said computer is in said booting state, and for initiating said service application if said register has been set.

25. The computer system according to claim 24, wherein said interrupt service routine calls an application in said operating system, and wherein said application initiates said service application.

26. A computer system according to claim 25, wherein said interrupt handler is coupled to said timer for initiating said timer substantially with receiving said first interrupt.

27. A computer system having a system BIOS and an operating system comprising:

a service button connected to a general purpose input register in a controller chip set for setting a bit in said register to generate a first interrupt signal;

an interrupt handler in said system BIOS for receiving said first interrupt signal and for initiating a second interrupt to said operating system to initiate a service application if said computer system is not executing a booting sequence; and

interrupt handler code contained in said operating system for checking the status of said bit during said booting

10

sequence and for initiating said service application if said bit has been set.

28. The computer system according to claim 27, wherein said interrupt handler code further comprises code for preventing said service button from generating subsequent interrupt signals until said first interrupt signal has been processed.

29. The computer system according to claim 28, further comprising code for notifying said system BIOS if said service application has not reached a predetermined point after a predetermined amount of time.

30. The computer system according to claim 29 further comprising code for initiating a predetermined reboot protocol if said service application has not reached said predetermined point after said predetermined amount of time.

31. The computer system according to claim 27, wherein said service button is accessible to a user from an external side of said computer system.

\* \* \* \* \*